WHAT IS CLAIMED IS:

1. An assembly comprising:

an actuator with a longitudinal axis having a fixed end, and a free end configured to translate in three orthogonal directions with respect to said fixed end;

a multiple bar linkage having first and second links mutually constrained to translate with respect to each other, and wherein said first link is fixed to a reference structure and said second link is constrained to translate in a direction generally parallel to the longitudinal axis of said actuator; and

a coupling having first and second ends, said first end being fixed to said actuator proximate to its free end, and said second end being fixed to said second link, the coupling adapted to transmit displacement in a direction substantially parallel to the longitudinal axis of said actuator.

2. The assembly of claim 1, wherein said actuator has a z-axis translating section, and an x and y-axis translating section disposed between said fixed end and said z-axis translating section.

3. The assembly of claim 2, wherein said reference structure is mechanically independent from translation of said z-axis translating section but mechanically responsive to said x and y-axis translating section.

4. The assembly of claim 3, wherein said reference structure is fixed to said multiple bar linkage to deflect said multiple bar linkage in X and Y directions in response to X and Y deflections of said x and y-axis translating stage.

5. The assembly of claim 4, wherein said multi-bar linkage further includes a first mirror fixed to at least one of said links of the multi-bar linkage, and a second mirror fixed to another of said links of said multi-bar linkage.

6. The assembly of claim 5, wherein the assembly is adapted to be supported in a chassis, and further wherein said first mirror is disposed in the path of a light beam from a light source mounted on said chassis and is disposed to reflect the light toward said second mirror.

7. The assembly of claim 1, wherein the metrology apparatus is a scanning probe microscope.

8. The assembly of claim 1, wherein said actuator is a piezoelectric actuator.

9. A scanning probe microscope assembly, comprising:

a microscope frame;

a piezoelectric actuator having a first end fixed to said frame and a second free end;

a first reflector assembly fixed proximate to said free end of said piezoelectric actuator;

a first electromagnetic radiation source fixed with respect to said frame and disposed to direct radiation onto said first reflector assembly; and

a fist electromagnetic radiation detector disposed to receive light from said first source after it has been received and reflected by said first reflector assembly and to generate a signal indicative of a degree of longitudinal deflection of said piezoelectric actuator.

10. The scanning probe microscope assembly of claim 9, further comprising cantilevered probe having a free end and a fixed end and fixed at its fixed end to said second free

end of said piezoelectric actuator, said probe including a second reflector disposed to translate with said probe when said probe is deflected with respect to said piezoelectric actuator.

11. The scanning probe microscope assembly of claim 10, further comprising a second electromagnetic radiation detector disposed to receive light reflected from said second reflector and to generate a signal indicative of a degree of deflection of said free end of said probe with respect to said fixed end of the probe.

12. An apparatus for measuring movement of an actuator in a metrology apparatus, the measuring apparatus comprising:

an optical measuring device including a light source that generates a light beam, said measuring device being configured to change the direction of said beam in response to movement of the actuator;

a sensor to detect said beam and generate a signal indicative of the movement of the actuator.

13. The apparatus of claim 12, wherein said light source is a laser.

14. The apparatus of claim 12, wherein said measuring device includes a movable bar assembly coupled to the actuator and to a reference structure, said bar assembly having a reflecting surface that is adapted to deflect said beam, and wherein said bar assembly is responsive to movement of the actuator so as to change the direction of said deflected beam.

15. The apparatus of claim 14, wherein said bar assembly includes a first link having a first end attached to the actuator and a second end, and a second link defining said reflecting surface and having a first opposed end rotatably attached to said second end and a second opposed end rotatably attached to said reference structure.

16. The apparatus of claim 14, wherein said reference structure is tubular and generally surrounds the actuator.

17. The apparatus of claim 16, wherein said reference structure is configured to allow said light beam and said deflected beam to pass therethrough.

18. The apparatus of claim 17, wherein said reference structure has an inner surface.

19. The apparatus of claim 18, further including a reflective surface fixed to said
inner surface to steer said beam toward said reflecting surface.

20. The apparatus of claim 14, wherein said bar assembly includes a link having opposed ends, a first opposed end rotatably attached to the actuator and a second opposed end rotatably attached to said reference structure.

21. The apparatus of claim 14, wherein said bar assembly comprises a four bar linkage including first and second reflecting surfaces, said surfaces disposed to reflect light such that the incoming and outgoing beams are generally parallel.

22. The apparatus of claim 12, wherein said optical measuring device includes a lens disposed intermediate said light source and said sensor.

23. The apparatus of claim 22, wherein said light source is mounted to the actuator.

24. The apparatus of claim 12, wherein the metrology apparatus is a scanning probe microscope.

25. The apparatus of claim 12, wherein the actuator is a piezoelectric actuator.

26. A method for measuring movement of an actuator in a metrology apparatus, the method comprising:

providing a movable bar assembly coupled to the actuator and to a reference structure; and

measuring, in response to movement of the actuator, movement of said movable bar assembly, wherein movement of said movable bar assembly is indicative of movement of the actuator.

27. The method of claim 26, wherein said movable bar assembly includes a first link having a first end attached to the actuator and a second end, and a second link defining said reflecting surface and having a first opposed end rotatably attached to said second end and a second opposed end rotatably attached to said reference structure.

28. An apparatus for measuring movement of an actuator, the apparatus comprising:

an optical measuring device including a source of electromagnetic radiation that generates a beam;

a sensor that detects a position of said beam; and

wherein, in response to movement of the actuator, said optical measuring device changes the position of said beam.

29. The apparatus of claim 28, further including a reference frame wherein said reference frame has a longitudinal axis that is generally co-linear with the longitudinal axis of the actuator.

30. The apparatus of claim 29, wherein said measuring device includes a movable bar assembly that is attached to said actuator at a first end of said bar assembly, and is attached to said reference frame at a second end of said bar assembly, and wherein said bar assembly defines a reflecting surface that reflects said beam towards said sensor.

31. The apparatus of claim 30, wherein said reference frame includes an inner surface and said measuring device further comprises a reflective surface fixed to said inner

surface that steers said beam towards said reflecting surface, said reflecting surface deflecting said beam towards said sensor.

32. The apparatus of claim 30, wherein said reference frame is configured to allow said beam and said deflected beam to pass therethrough.

33. The apparatus of claim 28, wherein said source is coupled to the actuator and directs the beam generally orthogonally to the movement of the actuator.

34. The apparatus of claim 33, wherein said measuring device further includes a lens intermediate said source and said sensor to focus said beam towards said sensor.

35. The apparatus of claim 33, wherein said source is fixed relative to the actuator and directs the beam generally orthogonally to the movement of the actuator.

36. The apparatus of claim 28, wherein said measuring device includes a lens that moves in conjunction with the actuator.

37. The apparatus of claim 28, wherein the actuator is a piezoelectric actuator.